FIITJEE

ALL INDIA TEST SERIES

CONCEPT RECAPITULATION TEST – I

JEE (Advanced)-2020

PAPER – 1

Time Allotted: 3 Hours **Maximum Marks: 183**

General Instructions:

- The test consists of total 54 questions.
- Each subject (PCM) has 18 questions.
- This question paper contains **Three Parts.**
- **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
- Each **Part** is further divided into **Two Sections**: **Section-A & Section-B.**

1. ***Section-A (01– 7, 19 – 25, 37 – 43)*** *contains 21 multiple choice questions which have* ***one or more than one correct*** *answer. Each question carries* ***+4 marks*** *for correct answer and* ***–2 marks*** *for wrong answer*
   Partial Marks **+1** for each correct option provided no incorrect option is selected.

   Section-A (08 – 13, 26 – 31, 44 – 49) *contains 18 questions. Each of 2 Tables with 3 Columns and 4 Rows has three questions. Column 1 will be with 4 rows designated (I), (II), (III) and (IV). Column 2 will be with 4 rows designated (i), (ii), (iii) and (iv). Column 3 will be with 4 rows designated (P), (Q), (R) and (S). Each multiple choice question with 4 options has* ***only one correct*** *answer and carries* ***+3 marks*** *for correct answer and* ***–1 mark*** *for wrong answer.*

2. ***Section–B (14 – 18, 32 – 36, 50 – 54)*** *contains 15 Numerical based questions with answers as numerical value from 0 to 9 and each question carries* ***+3 marks*** *for correct answer. There is no negative marking.*

Physics

PART – I

SECTION – A

(One or More than one correct type)

This section contains **07** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

1. If the dimensions of length are expressed as $G^x c^y h^z$; where G, c and h are the universal gravitational constant, speed of light and Planck's constant respectively, then

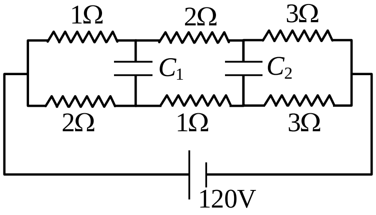
(A) $x = \frac{1}{2}, y = \frac{1}{2}$
(B) $x = \frac{1}{2}, z = \frac{1}{2}$
(C) $y = \frac{1}{2}, z = \frac{3}{2}$
(D) $y = -\frac{3}{2}, z = \frac{1}{2}$

2. A traveling wave pulse is given by $y = \frac{6}{2 + (x + 3t)^2}$ where symbols have their usual meanings, *x, y* are in metre and t is in second. Then

(A) the pulse is traveling along +ve *x*-axis with velocity 3 m/s
(B) the pulse is traveling along –ve *x*-axis with velocity 3 m/s
(C) the amplitude of the wave pulse is 3 m
(D) the pulse is a symmetric pulse

3. In the circuit shown in figure $C_1 = C_2 = 2\,\mu F$. Then charge stored in

(A) capacitor C_1 is zero
(B) capacitor C_2 is zero
(C) both capacitors is zero
(D) capacitor C_1 is 40 μC

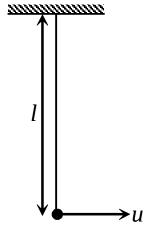


Space for Rough work

4. A particle of mass *m* moves in a straight line. If *v* is the velocity at a distance *x* from a fixed point on the line and $v^2 = a - bx^2$, where *a* and *b* are constant, then
(A) the motion continues along the positive *x*-direction only
(B) the motion is simple harmonic\
(C) the particle oscillates with a frequency equal to $\frac{\sqrt{b}}{2\pi}$
(D) the total energy of the particle is *ma*

5. When a monochromatic point source of light is at a distance of 0.2 m from a photoelectric cell, the cut off voltage and the saturation current are respectively 0.6V and 18.0 mA. If the same source is placed 0.6 m away from the photoelectric cell, then:
(A) the stopping potential will be 0.2 volt
(B) the stopping potential will be 0.6 volt
(C) the saturation current will be 6.0 mA
(D) the saturation current will be 2.0 mA

6. A particle of mass m is attached to one end of the light inextensible string and other end of the string is fixed in vertical plane as shown. Now particle is given horizontal velocity $u = \sqrt{\frac{5}{2}gl}$, then which of the following statement/s is/are correct.



(A) The string makes angle with the downward vertical is 60^0 when acceleration of the particle is horizontal.
(B) The tension in string is 2 mg when acceleration of the particle is horizontal.
(C) The speed of the particle is $\sqrt{\frac{3}{2}gl}$ when acceleration of the particle is horizontal
(D) The particle will not complete the circle.

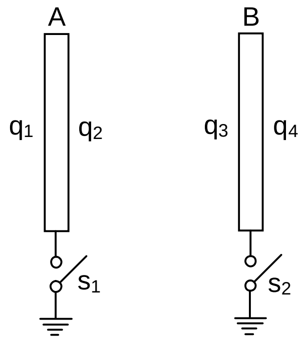
7. The potential energy φ in joule of a particle of mass 1 kg moving in the x – y plane, obeys the law $\varphi = 3x + 4y$, where (x, y) are the coordinate of the particle in metre. If the particle is at rest at (6, 4) at time t = 0, then (only conservative force are acting on particle).
(A) the particle has constant acceleration
(B) the work done by the conservative forces from position of rest of the particle to the instant of the particle crossing x axis is 25 J
(C) the speed of the a particle when it crosses the y axis is 10 ms^{-1}
(D) the coordinates of the particle at time t = 4s are (–18, –28)

Space for Rough work

(Matching type - Single Correct Option)

This section contains **SIX** questions of matching type. The section contains **TWO** tables (each having 3 columns and 4 rows). Based on each table, there are **THREE** questions. Each question has **FOUR** options (A), (B), (C), and (D). **ONLY ONE** of these four options is correct.

Answer questions 8, 9 and 10 by appropriately matching the information given in the three columns of the following table.

<table>
<tr><td colspan="2">In the figure given below, plate A has 100μC charge, while plate B has 60 μC charge. Switches S_1 and S_2 are connected to the ground. q_1, q_2, q_3 and q_4 are charges on faces of plates as shown in figure</td><td> </td></tr>
<tr><th>Column 1</th><th>Column 2</th><th>Column 3</th></tr>
<tr><td>(I) q_1 =80 μC</td><td>(i) q_2= 100 μC</td><td>(P) q_3= -20 μC</td></tr>
<tr><td>(II) q_1 = 60 μC</td><td>(ii) q_2= 0 μC</td><td>(Q) q_3= -100 μC</td></tr>
<tr><td>(III) q_1 = 0 μC</td><td>(iii) q_2= 20 μC</td><td>(R) q_3= 60 μC</td></tr>
<tr><td>(IV) q_1 = -60 μC</td><td>(iv) q_2= 60 μC</td><td>(S) q_3= 0 μC</td></tr>
</table>

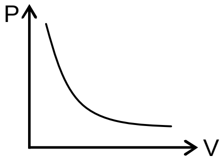
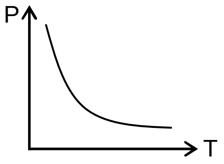
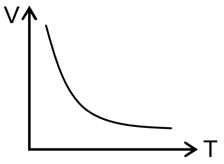
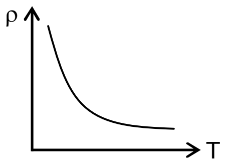
8. Which of the following options correctly represents the case when switch S_1 is closed and S_2 is open?
(A) (IV)(ii) (P)
(B) (III) (i) (R)
(C) (III) (iv) (S)
(D) (II) (iii) (Q)

9. Which of the following options correctly represents the case when switch S_2 is closed and S_1 is open?
(A) (IV)(ii) (P)
(B) (III) (i) (Q)
(C) (II) (i) (Q)
(D) (II) (iii) (Q)

10. Which of the following options correctly represents the case when both the switches S_1 and S_2 is open?
(A) (I)(ii) (P)
(B) (IV) (iv) (P)
(C) (I) (ii) (S)
(D) (II) (iii) (Q)

Space for Rough work

Answer questions 11, 12 and 13 by appropriately matching the information given in the three columns of the following table.

<table>
<tr><td colspan="3">Column 1 shows rectangular hyperbola graphs, Column 2 shows molar heat capacities for monoatomic gases and Column 3 shows work done when process goes from initial state 1 to final state 2.</td></tr>
<tr><th>Column 1</th><th>Column 2</th><th>Column 3</th></tr>
<tr><td>(I)  </td><td>(i) $C = \frac{7R}{2}$</td><td>(P) $\Delta W = nR(T_2 - T_1)$</td></tr>
<tr><td>(II)  </td><td>(ii) $C = \frac{R}{2}$</td><td>(Q) $\Delta W = -nR(T_2 - T_1)$</td></tr>
<tr><td>(III)  </td><td>(iii) $C = \frac{5R}{2}$</td><td>(R) $\Delta W = 2nR(T_2 - T_1)$</td></tr>
<tr><td>(IV)  </td><td>(iv) $C = \infty$</td><td>(S) $\Delta W = nRT \ln\frac{V_2}{V_1}$</td></tr>
</table>

11. Which option matches the data for an isobaric process?
(A) (IV) (iv) (P) (B) (III) (iii) (P)
(C) (IV) (iii) (P) (D) (III) (i) (Q)

12. Which of the following options is a correct combination?
(A) (II) (iii) (R) (B) (III) (ii) (Q)
(C) (III) (iii) (Q) (D) (II) (ii) (Q)

13. Which option matches the data for a process whose $\Delta U = 0$?
(A) (IV) (ii) (S) (B) (II) (iv) (S)
(C) (I) (ii) (Q) (D) (I) (iv) (S)

Space for Rough work

SECTION – B

(Single digit integer type)

This section contains **FIVE** questions. The answer to each question is a single Digit integer ranging from 0 to 9, both inclusive.

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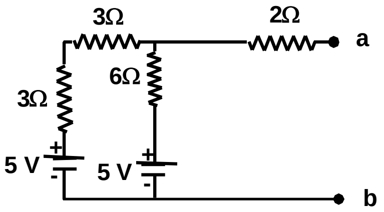
14. If voltage V = (100 ± 5) V and current I = (10 ± 0.2) A, the percentage error in resistance R is

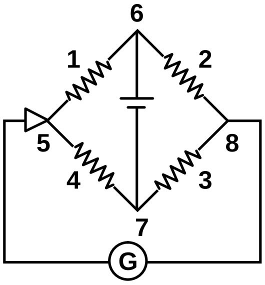
15. Determine the resistance in ohm is to be connected across a, b in given circuit to dissipate maximum power through it.



16. An ideal gas is expanding such that PT^2 = constant. The coefficient of volume expansion of the gas is A/T where T is temperature in Kelvin. Find the value of A.

17. A point source of power 4W is placed 1m below the free surface of liquid whose refractive index is $'\frac{2}{\sqrt{3}}'$. Find the rate of transfer of energy (in watt) from the liquid surface to air. Ignore any absorption or scattering of light energy.

18. Four wires of equal length 8 m are arranged as shown in the figure. Wires, 2, 3 and 4 are of equal cross sectional area and wire 1 is of half the cross section of these wires. By how much distance pointer at point 5 must be moved to get null point?



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Chemistry PART – II

SECTION – A

(One or More than one correct type)

This section contains **07** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

19. Which of the following statement(s) is/are correct for the following reaction?

$$(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} Cr_2O_3 + N_2 + 4H_2O$$

(A) The equivalent mass of $(NH_4)_2Cr_2O_7$ (Mol. mass = M) is $\frac{M}{6}$
(B) It is a disproportionation reaction
(C) It is an intermolecular redox reaction
(D) One mole of reactant on complete reaction produces 22.4 L of N_2 gas at NTP.

20. Which of the following solution(s) behave(s) as buffer?

(A) HCOOH + HCOOK
(B) $NaH_2PO_4 + Na_2HPO_4$
(C) $H_2SO_4 + NaHSO_4$
(D) $H_2CO_3 + NaHCO_3$

21. $H_2O_2 + H^+ + I^- \longrightarrow I_2 + H_2O$

On investigation of the above reaction, the following results were obtained.

Initial conc. of reactant in M			Initial rate of formation of I_2 in mol dm^{-3} s^{-1}
$[H_2O_2]$	$[I^-]$	$[H^+]$	
0.01	0.01	0.30	2×10^{-6}
0.03	0.01	0.30	6×10^{-6}
0.03	0.02	0.10	1.2×10^{-5}
0.03	0.02	0.20	1.2×10^{-5}

Choose the correct statement(s)
(A) The rate equation for the reaction is Rate = $k[H_2O_2][I^-]$.
(B) The reaction is zero order with respect to acid.
(C) The reaction is termolecular.
(D) The rate constant is 2×10^{-1} mol^{-2} dm^6 s^{-1}.

Space for Rough work

22. Which of the following gas(es) can effuse faster than CH_4 under identical conditions?
(A) H_2 (B) He
(C) SO_2 (D) CO_2

23. Which of the following substance(s) produce(s) halogen gas when react(s) with conc. H_2SO_4?
(A) NaI (B) KF
(C) NaCl (D) KBr

24. Which of the following ion(s) maintain an identical d-orbital configuration while forming octahedral complexes with strong field as well as weak field ligands according to crystal field theory?
(A) Fe^{2+} (B) Co^{2+}
(C) Ni^{2+} (D) Zn^{2+}

25. Choose correct statement(s) about the following compound.
$CH_3 – CH = CH – CH = CH – CH_3$
(A) It shows three geometrical isomers
(B) It shows four geometrical isomers
(C) It forms a dicarboxylic acid on acidified permanganate oxidation
(D) It forms two moles of CH_3COOH on oxidation

(Matching type - Single Correct Option)

This section contains **SIX** questions of matching type. The section contains **TWO** tables (each having 3 columns and 4 rows). Based on each table, there are **THREE** questions. Each question has **FOUR** options (A), (B), (C), and (D). **ONLY ONE** of these four options is correct.

Answer questions 26, 27 and 28 by appropriately matching the information given in the three columns of the following table.

Column – 1		**Column – 2**		**Column – 3**	
(I)	Primitive cubic	(i)	8	(P)	Corner
(II)	Face centre cubic	(ii)	6	(Q)	Body centre
(III)	Body centre cubic	(iii)	12	(R)	Edge centre
(IV)	Hexagonal close packing	(iv)	4	(S)	Voids

26. Which combination is correct for the position of Na^+ in NaCl solid?
(A) (IV), (iv) & (R) (B) (II), (iii) & (Q)
(C) (II), (ii) & (R) (D) (III), (i) & (Q)

Space for Rough work

27. Which combination is correct for the lattice of CsCl?
(A) (III), (i) & (R) (B) (II), (i) & (P)
(C) (III), (i) & (Q) (D) (IV), (iii) & (Q)

28. Which combination is correct for a metallic solid having simple cubic unit cell?
(A) (IV), (ii) & (R) (B) (I), (i) & (P)
(C) (II), (i) & (Q) (D) (I), (ii) & (P)

Answer questions 29, 30 and 31 by appropriately matching the information given in the three columns of the following table.

Column – 1		**Column – 2**		**Column – 3**	
(I)	CH_3COCH_3	(i)	HNO_2	(P)	Disproportionation reaction takes place
(II)	HCHO	(ii)	Conc. NaOH	(Q)	Colourless and acidic gas is formed
(III)	CH_3COOH	(iii)	$NaHCO_3$	(R)	Sweet fruity smell is observed
(IV)	$CH_3CH_2NH_2$	(iv)	C_2H_5OH/H^+	(S)	Colourless and neutral gas is formed

29. Which combination is correct for Cannizzaro reaction?
(A) (I), (iii) & (R) (B) (II), (ii) & (P)
(C) (IV), (ii) & (P) (D) (III), (i) & (R)

30. Which combination produces an alcohol?
(A) (III), (ii) & (Q) (B) (I), (iii) & (S)
(C) (IV), (i) & (S) (D) (I), (iv) & (Q)

31. Which combination produces an ester?
(A) (IV), (iii) & (R) (B) (II), (i) & (S)
(C) (III), (iv) & (R) (D) (I), (iii) & (S)

Space for Rough work

SECTION – B

(Single digit integer type)

This section contains **FIVE** questions. The answer to each question is a single Digit integer ranging from 0 to 9, both inclusive.

32. The rate of effusion of an unknown gas is four times that of SO_2. What is the molecular mass of the unknown gas?

33. The solubility product of a salt MX is 16×10^{-4}. If the molarity of its saturated solution is expressed as $x \times 10^{-y}$, the value of (x + y) is:

34. How many structural isomer(s) containing four membered ring(s) is/are possible with formula C_4H_5F?

35. How many maximum no. of moles of CH_3I can be absorbed by one mole of $C_2H_5NH_2$?

36. What is the coordination number of Zn^{2+} in ZnS crystal?

Space for Rough work

Mathematics PART – III

SECTION – A
(One or More than one correct type)

This section contains **07** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

37. Consider the function $f(x)=\left[\cos\left(\tan^{-1}\left(\sin\left(\cot^{-1}x\right)\right)\right)\right]^2$. Which of the following is correct?
(A) Range of f is (0, 1)
(B) f is even
(C) $f'(0)=0$
(D) The line y = 1 is asymptote to the graph $y=f(x)$

38. Let $\vec{a}=\begin{bmatrix}1\\0\\-3\end{bmatrix},\vec{b}=\begin{bmatrix}2\\1\\0\end{bmatrix},\vec{c}=\begin{bmatrix}1\\-1\\1\end{bmatrix}$. If the numbers α,β and γ are such that $\alpha\vec{a}+\beta\vec{b}+\gamma\vec{c}=\begin{bmatrix}-2\\-5\\6\end{bmatrix}$ then
(A) $\alpha=-1$ (B) $\beta=-2$
(C) $\gamma=3$ (D) $\alpha+\beta+\gamma=0$

39. Two tangents can be drawn to the different branches of hyperbola $\frac{x^2}{1}-\frac{y^2}{4}=1$ from the point $\left(\alpha,\alpha^2\right)$, if:
(A) $\alpha\in(-2,0)$ (B) $\alpha\in(0,2)$
(C) $\alpha\in(-\infty,-2)$ (D) $\alpha\in(2,\infty)$

Space for Rough work

40 3 married couples are to seated around a circular table. Let x denotes the number of ways where atmost two couples sit together and let y denotes the number of ways where two particular couples sit together, then identify the correct option(s)

(A) $x-8y=60$ (B) $x+y=112$

(C) $x=13y$ (D) $x=12y$

41. If $\left(9+\sqrt{80}\right)^n = I+f$ where I and n are integers and $0<f<1$, then:

(A) I is an odd integer (B) I is an even integer

(C) $\left(I+f\right)\left(1-f\right)=1$ (D) $1-f=\left(9-\sqrt{80}\right)^n$

42. If $f(x)$ and $g(x)$ are function such that $f(x+y)=f(x)g(y)+g(x)f(y)$, then

$\begin{vmatrix} f(\alpha) & g(\alpha) & f(\alpha+\theta) \\ f(\beta) & g(\beta) & f(\beta+\theta) \\ f(\gamma) & g(\gamma) & f(\gamma+\theta) \end{vmatrix}$ is independent of:

(A) α (B) β

(C) γ (D) θ

43. The equation $\dfrac{b\cos x}{2\cos 2x-1}=\dfrac{b+\sin x}{\left(\cos^2 x-3\sin^2 x\right)\tan x}$ possess a solution if

(A) $b<\dfrac{1}{2}$ (B) $0<b<\dfrac{1}{2}$

(C) $b<0$ (D) $b=\dfrac{1}{2}$

Space for Rough work

(Matching type - Single Correct Option)

This section contains **SIX** questions of matching type. The section contains **TWO** tables (each having 3 columns and 4 rows). Based on each table, there are **THREE** questions. Each question has **FOUR** options (A), (B), (C), and (D). **ONLY ONE** of these four options is correct.

Answer questions 44, 45 and 46 by appropriately matching the information given in the three columns of the following table.

Consider three plans:

$P_1 \equiv 2x + y + z = 1$

$P_2 \equiv x - y + z = 2$

$P_3 \equiv \alpha x - y + 3z = 5$

The three planes intersects each other at point P on XOY plane and at point Q on YOZ plane. O is the origin.

Column 1	Column 2	Column 3
(I) The value of α is	(i) 1	(P) root of equation $x^2 - x(4+i) + 4i = 0$
(II) The length of projection of PQ on x – axis is	(ii) 2	(Q) root of equation $x^2 - 1 = 0$
(III) If the coordinates of point R situated at minimum distance from point O on the line PQ are (a, b, c), then the value of $7a + 14b + 14c$ is	(iii) 4	(R) root of equation $x^3 - 8 = 0$
(IV) If the area of ΔPOQ is $\sqrt{\frac{a}{b}}$. Then the value of a – b is where a and b are co – prime numbers	(iv) 3	(S) root of equation $x^2 + 2x - 15 = 0$

44. Which is correct combination?
(A) (I) (i) (P)
(B) (I) (iii) (P)
(C) (II) (ii) (Q)
(D) (III) (ii) (Q)

Space for Rough work

45. Which is correct combination?
    (A) (I) (ii) (Q)　　(B) (II) (i) (Q)
    (C) (III) (iii) (R)　　(D) (IV) (iv) (Q)

46. Which is correct combination
    (A) (I) (ii) (Q)　　(B) (III) (ii) (R)
    (C) (IV) (iv) (R)　　(D) (I) (ii) (R)

Answer questions 47, 48 and 49 by appropriately matching the information given in the three columns of the following table.

Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix}$ and X_1, X_2, X_3 be three column matrices such that $AX_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$, $AX_2 = \begin{bmatrix} 2 \\ 3 \\ 0 \end{bmatrix}$ and $AX_3 = \begin{bmatrix} 2 \\ 3 \\ 1 \end{bmatrix}$ and X is a 3×3 matrix whose columns are X_1, X_2, X_3 then

Column 1	Column 2	Column 3
(I) Value of $\det(X)$ is	(i) –3	(P) 7th term of A.P. whose first 3 terms are $\frac{1}{2}, \frac{13}{18}, 1$ respectively
(II) $3\det(A)$ is	(ii) 3	(Q) 11th term of A.P. whose first 3 terms are $\frac{1}{2}, \frac{3}{4}, 1$ respectively
(III) $\left[\det(\text{adj})X\right]^{1/2}$	(iii) 0	(R) 9th term of A.P. whose first 3 terms are $\frac{1}{3}, \frac{7}{24}, \frac{1}{4}$ respectively
(IV) Sum of the elements of X^{-1} is	(iv) –1	(S) 10th term of A.P. whose first 3 terms are $\frac{1}{3}, \frac{7}{24}, \frac{1}{4}$ respectively

47. Which is correct combination?
    (A) (I) (i) (P)　　(B) (I) (iii) (P)
    (C) (II) (ii) (Q)　　(D) (III) (ii) (R)

Space for Rough work

48. Which is correct combination?

(A) (I) (ii) (Q)	(B) (II) (i) (Q)
(C) (III) (iii) (R)	(D) (IV) (iv) (Q)

49. Which is correct combination?

(A) (I) (ii) (S)	(B) (III) (ii) (Q)
(D) (IV) (iv) (S)	(D) (I) (ii) (R)

SECTION – B

(Single digit integer type)

This section contains **FIVE** questions. The answer to each question is a single Digit integer ranging from 0 to 9, both inclusive.

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50. If α, β, γ are roots of equation $f(x) = 0$ where $f(x) = x^3 - cx^2 + 4x - 2$ and $f\left(\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma}\right) = 2$ then value of c is:

51. Let $0 \le \beta_r \le 1$ and $\sum_{r=1}^{k} \cos^{-1} \beta_r = \frac{k\pi}{2}$ for any $k \ge 1$ and $A = \sum_{r=1}^{k} (\beta_r)^r$, then $\lim_{x \to A} 498.\frac{(1+x^2)^{1/3} - (1-2x)^{1/4}}{x + x^2}$ is equal to λ, where $\frac{\lambda}{83} =$

Space for Rough work

52. The vertices of a triangle are A (1, 0, 0), B (0, 2, 0) and C (0, 0, 3). If $\left(a\hat{i}+b\hat{j}+c\hat{k}\right)$ is position vector of othrocenter of ΔABC then $\sqrt{\dfrac{6}{(a-b-c)}}$ is

53. Let Δ_1 be the area of ΔPQR inscribed in an ellipse $\dfrac{x^2}{a^2}+\dfrac{y^2}{b^2}=1(a>b)$ and Δ_2 be the area of the $\Delta P'Q'R'$ whose vertices are the points lying on the auxiliary circle corresponding to the points P, Q, R, respectively. If the eccentricity of the ellipse is $\dfrac{4\sqrt{3}}{7}$, then the ratio $\dfrac{\Delta_2}{\Delta_1}$ must be ___

54. Let PQ be a variable normal chord of the parabola $y^2=4x$ whose focus is S. If the locus of the centroid of the triangle SPQ is the curve $gy^2(3x-5)=ky^4+w$ where g, k, w, $\in N$, find the value of $w-(g+k+2)$

Space for Rough work